Ventilator-Associated Pneumonia Prevention

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Basics of Infection Prevention
2-Day Mini-Course
October-November 2011

Objectives

- Review the epidemiology of VAP definitions and the impact in the ICU
- Explore causes and mechanisms of VAP, focusing on modifiable factors
- Discuss evidence-based VAP prevention strategies
- Describe surveillance of VAP and problems associated with definitions

Ventilator Associated Pneumonia (VAP)

- VAP is pneumonia that occurs in patients intubated and on mechanical ventilation
  - or intubated/ventilated within 48 hours prior to pneumonia onset
- 15% - 50% patients with VAP die
  - varies with patient population and organism type
- Highest VAP mortality occurs inpatients with
  - severe illness **and**
  - infection with nonfermentative Gram negative bacilli
    e.g. Acinetobacter sp, Burkholderia sp., etc.
- Increases length of stay >6 ICU days
  - Cost $10,000 - $40,000

Etiology of VAP

Early onset VAP

- Occurs in first 4 days of hospitalization
- More likely to be caused by *Moraxella catarrhalis*, *H. influenzae,* or *S. pneumoniae*

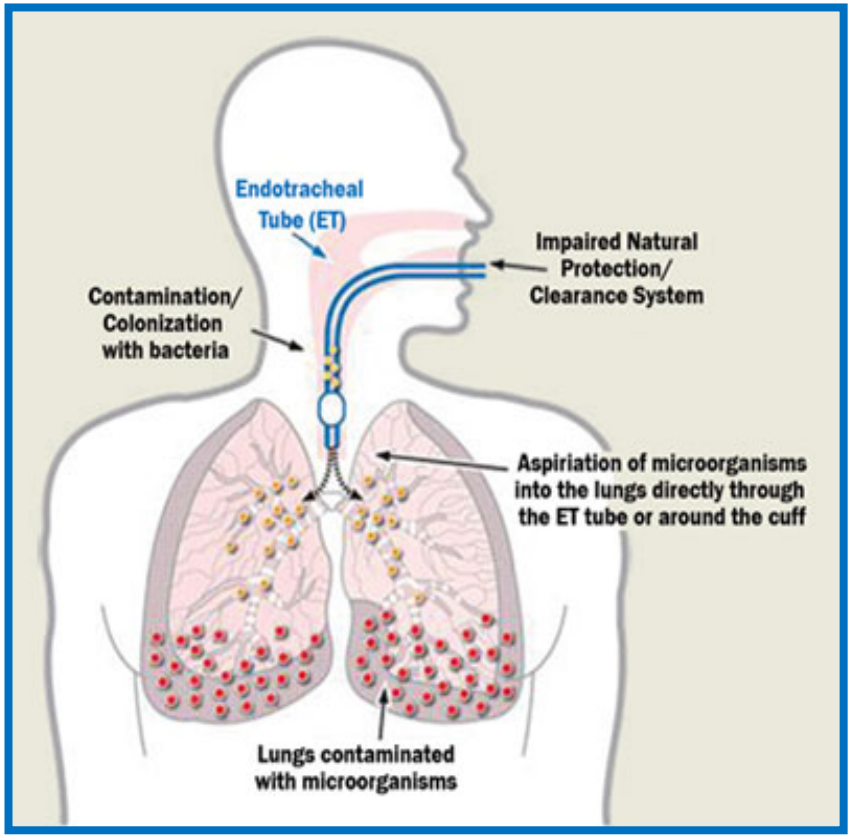
Late onset VAP:

- Occurs 5 or more days into hospitalization
- Often caused by Gram-negative bacilli, or *S. aureus* (including MRSA), yeasts, fungi, *legionellae* and *Pneumocystis carnii*

Pathogenesis VAP Development

Results from

- Aspiration of secretions
- Colonization of aerodigestive tract
- Contaminated respiratory / other medical equipment



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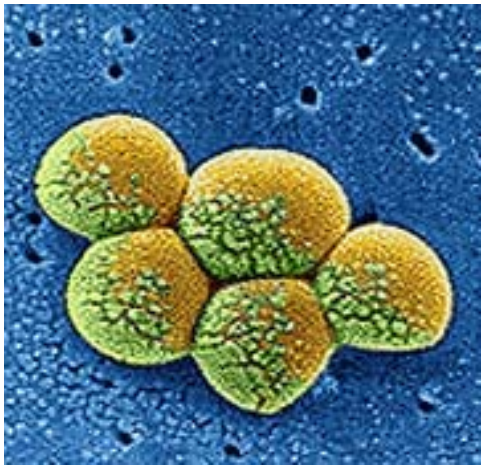
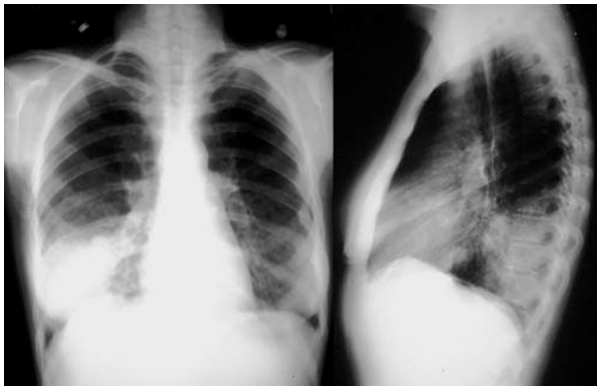
VAP Pathogens

- *Staphylococcus aureus* - 24.4%
- *Pseudomonas aeruginosa* - 16.3%
- *Enterobacter spp* - 8.4%
- *Acinetobacter baumannii* - 8.4%
- *Klebsiella pneumoniae* - 7.5%
- *Escherichia coli* - 4.6%
- *Candida spp* - 2.7%
- *Klebsiella oxytoca* - 2.2%
- *Coagulase-negative staphylococci* - 1.3%



Diagnosis of Pneumonia



Pneumonia has rapid onset and progression, but does not resolve quickly

X-ray changes related to pneumonia can persist for several weeks

Fast resolution of x-ray changes usually suggest a non-infectious process

VAP Prevention

Issue: **Aspiration of secretion**s

- Maintain elevation of head of bed (HOB) (30-45 degrees)
- Avoid gastric over-distention
- Avoid unplanned extubation/reintubation
- Use cuffed endotracheal tube with in-line or subglottic suctioning

Prevention of VAP

Issue: **Aspiration of secretions** (continued)

- Positioning
  - Semi-recumbent position (head of bed 30º-45º) unless contraindicated
    - Place reminders at HOB or on posters in room
    - Add HOB to daily goal list/ ICU record
    - Tape 45º goal on bed for visual reminder
    - Give staff feedback on compliance
- Encourage early mobilization of patients with physical/occupational therapy

VAP Prevention

Issue: **Aspiration of secretions** (continued)

- Reduce duration of ventilation
  - Conduct “sedation vacations”
  - Assess readiness to wean from vent daily
  - Conduct spontaneous breathing trials

VAP Prevention

Issue: **Colonization of aerodigestive tract**

- Orotracheal intubation is preferred to nasotracheal intubation
  - Sinusitis may increase VAP risk
- Avoid acid suppressive therapy for patients not at high risk for stress ulcer/stress gastritis
  - May increase colonization of aerodigestive tract with pathogens
- Perform regular oral care with an antiseptic agent

Prevention of VAP Development

Issue: **Colonization of aerodigestive tract -2**

- Endotracheal Tube (ETT)
  - Use cuffed ETT with inline or subglottic suctioning to minimize secretions above cuff, and prevent contamination from entering lower airway
- Use non-invasive methods when possible (i.e., CPAP, BiPap)
- Use orotracheal ventilation (nasotracheal ventilation may cause sinusitis, increasing bacteria colonization)

Prevention of VAP Development

Issue: **Colonization of aerodigestive tract - 3**

- Reduce bacterial colonization
  - Good hand hygiene
  - Use gloves for contact with respiratory secretions/contaminated objects; follow with hand hygiene
  - Educate about potential contamination of ETT from mouth, hands, other infected sites and environment
  - Regular mouth care with an antiseptic

Prevention of VAP Development

Issue: **Use of contaminated equipment**

- Use sterile H20 to rinse reusable respiratory equipment
- Remove condensate from ventilatory circuits
- Change ventilatory circuit only when malfunctioning or visibly soiled
- Store and disinfect respiratory equipment effectively

Challenges in VAP Prevention

- Pre-existing conditions:
  - Head trauma
  - Coma
  - Nutritional deficiencies
  - Immunocompromise
  - Multi organ system failure
  - Acidosis
  - Comorbidities
  - History of smoking or pulmonary disease

VAP Prevention

- Leadership, staffing, informatics and education are essential to VAP reduction programs
- VAP prevention teams must be multidisciplinary, including
  - Senior management
  - MD / RN clinical champion
  - Frontline staff

Identifying VAP

- Follow NHSN protocols for surveillance
- Work with ICU and respiratory therapy staff to develop process for alerting to possible VAP
- Evaluate ventilated patients
  - Positive cultures
  - Chest films (X-ray, MRI, CT)
  - Temperature chart/log
  - Pharmacy reports of antimicrobial use
  - Change in respiratory secretions

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VAP Prevention Objectives

- Health and Human Services (HSS) HAI Prevention Action Plan, 2009
  - No valid outcome or process metrics have been identified for VAP

http://www.hhs.gov/ash/initiatives/hai/prevtargets.html

VAP Prevention Process Measures

Consider monitoring

- Compliance with hand hygiene
- Compliance with daily sedation vacation/interruption and assessment of readiness to wean
- Compliance with regular antiseptic oral care
- Compliance with semi-recumbent position of all eligible patients

VAP Prevention Outcome Measures

$$\frac{\text{\# Patients with VAP}}{\text{Total \# of ventilated patients}} \times 100$$

- Crude, unadjusted rate
- Not for inter-hospital or between-unit comparisons

$$\frac{\text{\# VAP}}{\text{Total \# of ventilator days}} \times 1000$$

- Incidence-density rate
- Accounts for differences in exposure risk; can be used for rate comparison to similar patient populations stratification

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VAP Surveillance

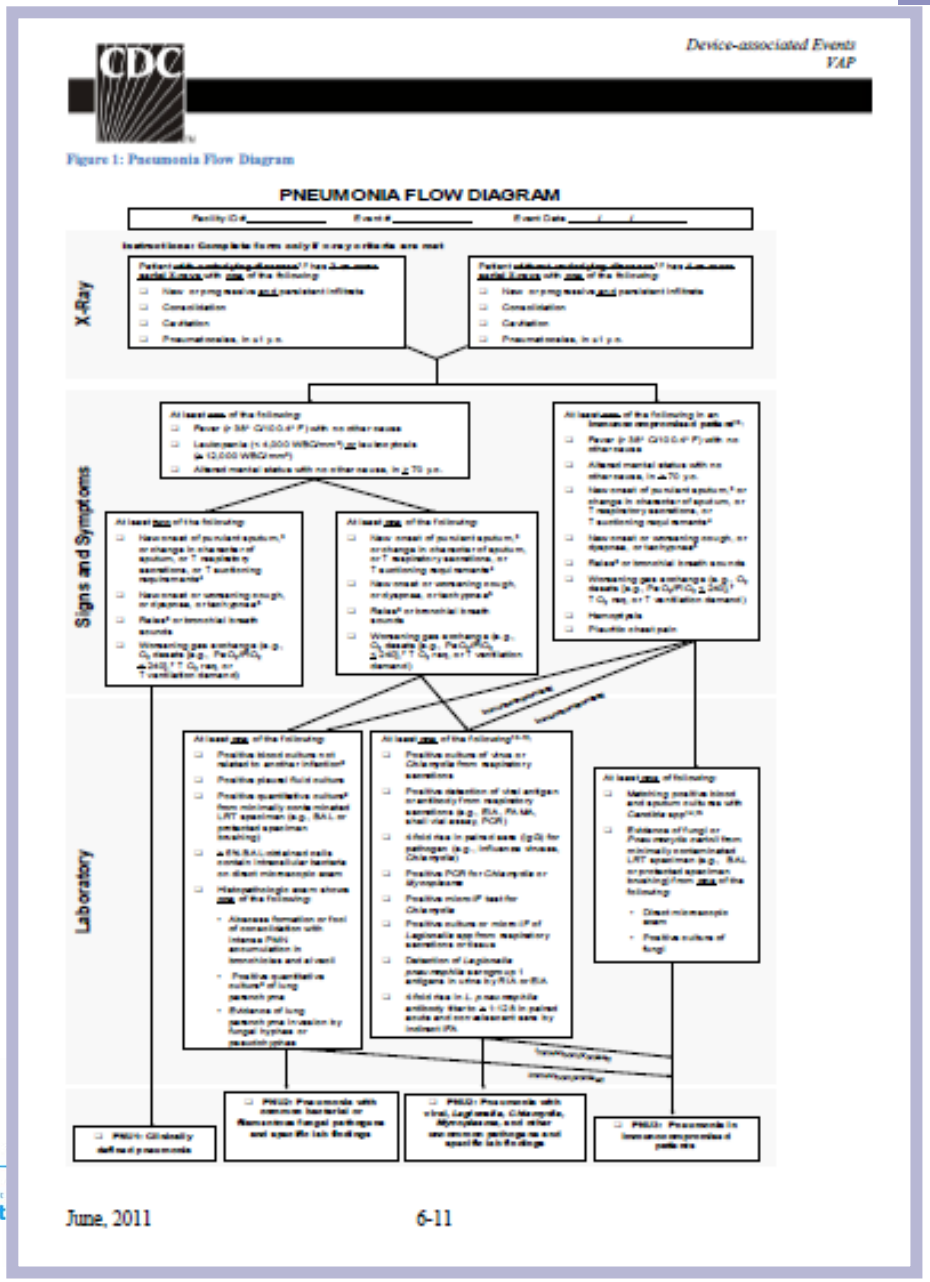
- VAP case finding is complex
- Despite common definition, variability exists between reviewers
- CDC currently evaluating new definition system

NHSN Pneumonia Definition

VAP is HAI pneumonia occurring in ventilated patient (or extubated within previous 48 hours)

Surveillance definition can be met by 3 different criteria

- Clinically defined pneumonia (PNU1)
- Pneumonia with specific laboratory findings (PNU2)
- Pneumonia in immunocompromised patients (PNU3)



NHSN pneumonia surveillance definition algorithm (all ages)

IMPORTANT: As you go through the following set of slides, do not get caught up in definition and interpretation problems (we know there are many)

At <u>your</u> facility, decide how the definition will be interpreted and applied, then be consistent over time!

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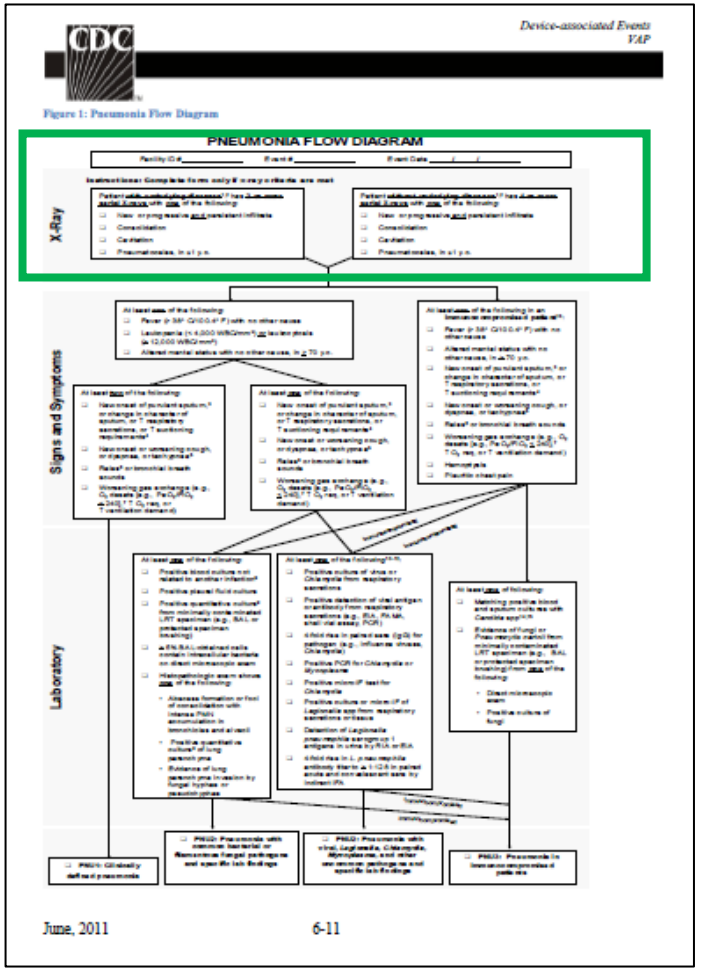
NHSN Pneumonia Definition Algorithm

Positive chest X-rays findings required to start

- new or progressive and persistent infiltrates, consolidation or cavitation on one or more serial x-rays
- if patient has underlying cardiac or pulmonary disease, 2 or more serial x-rays necessary



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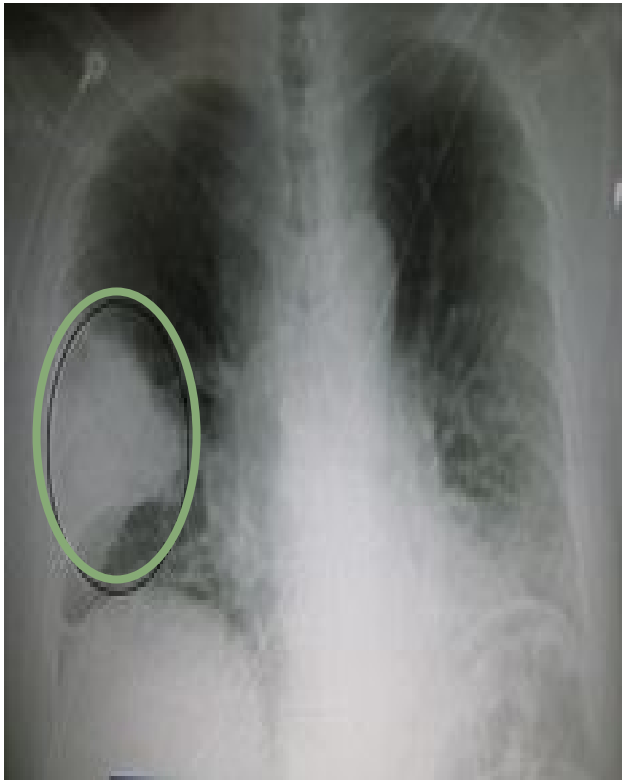
NHSN Pneumonia Definition Algorithm

Chest X-rays: the following descriptions may be indicative of pneumonia:

- Infiltration
- Consolidation
- Cavitation
- Focal opacification
- Patchy density
- Air space disease



Or

- Pneumatocele in infants (< 1 year age)

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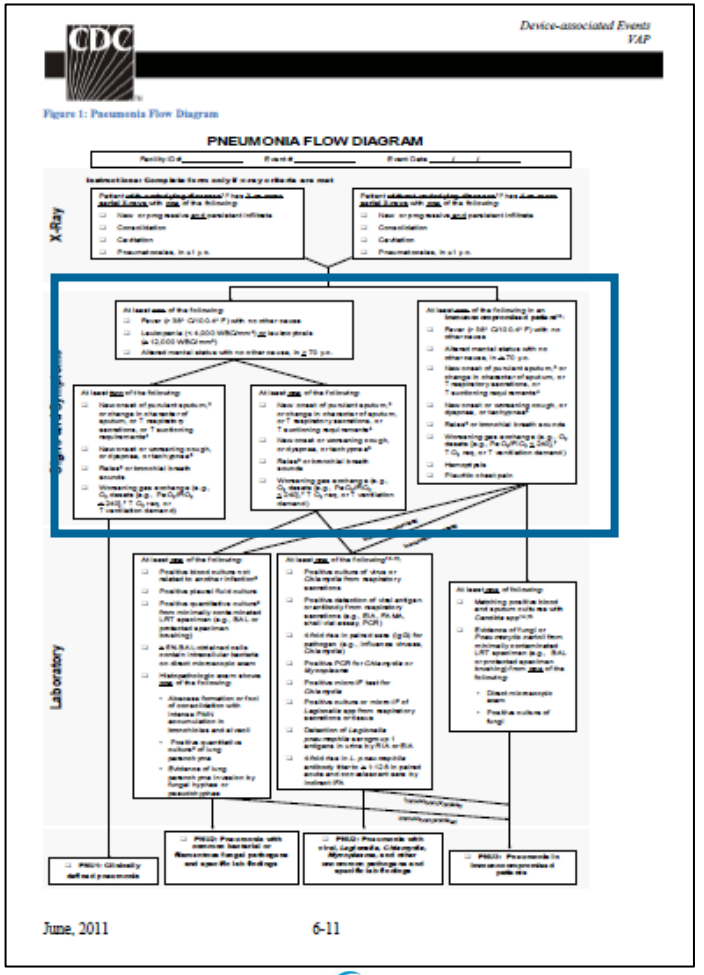
NHSN Pneumonia Definition Algorithm

Second part of algorithm addresses signs and symptoms of pneumonia

- Fever (with no other cause)
- WBC (leukopenia or leukocytosis)
- Altered mental status (>70 yr old)
- Sputum characteristics
- Cough
- Breath sounds
- Gas exchange



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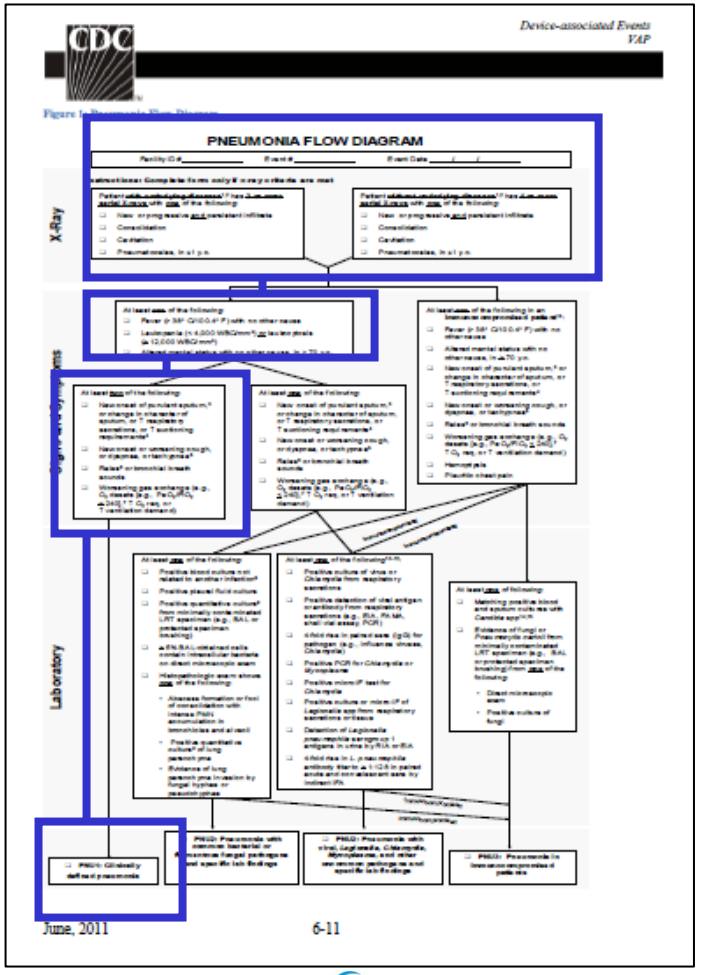
NHSN Pneumonia Definition Algorithm

Clinically defined pneumonia (PNU1)

- Definition can be met if +chest x-rays and signs/ symptoms meet criteria

- No laboratory data required



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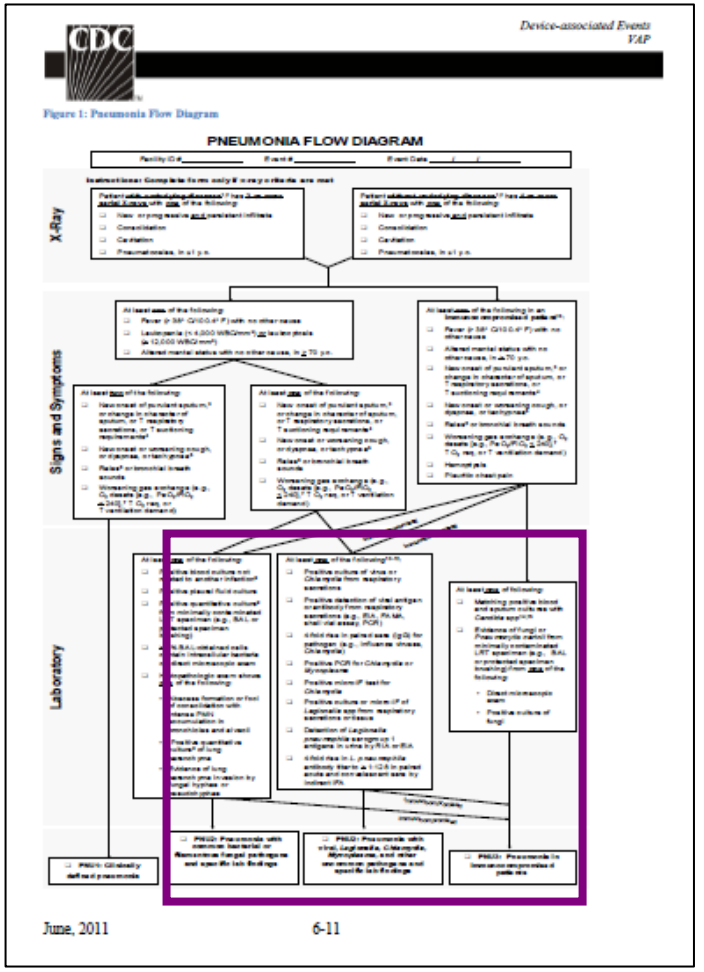
NHSN Pneumonia Definition Algorithm

Third part of the algorithm addresses laboratory findings for pneumonia



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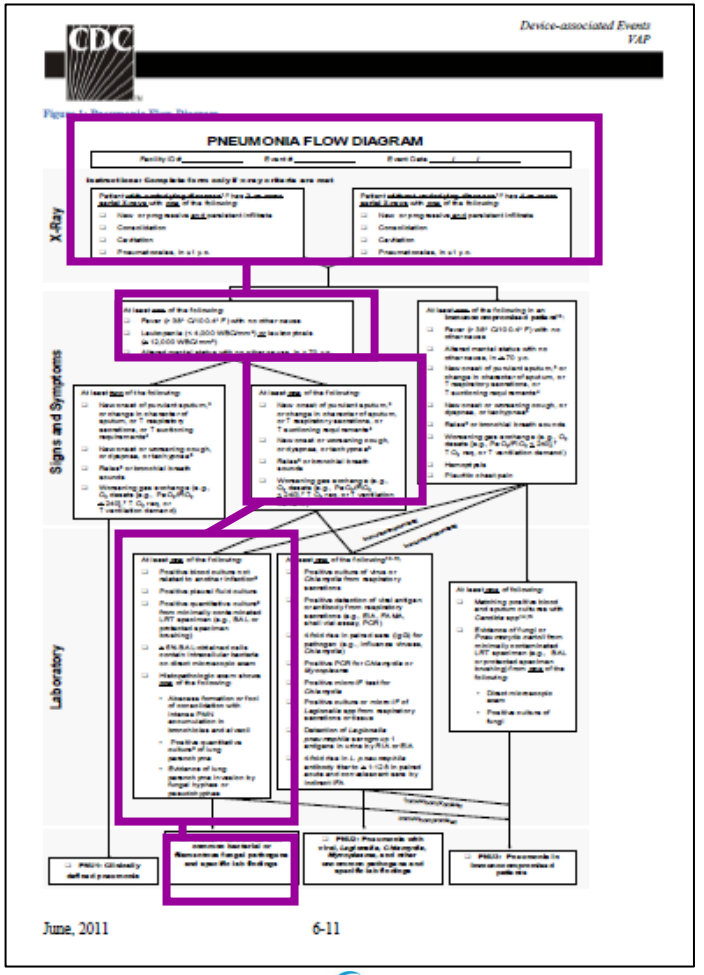
NHSN Surveillance Definition Algorithm

Laboratory defined pneumonia (PNU2)

Criteria can be met in two ways:

1. Pneumonia with common bacterial or filamentous fungal pathogens **and** specific lab findings

    - X-ray, signs & symptoms and lab data criteria must be met



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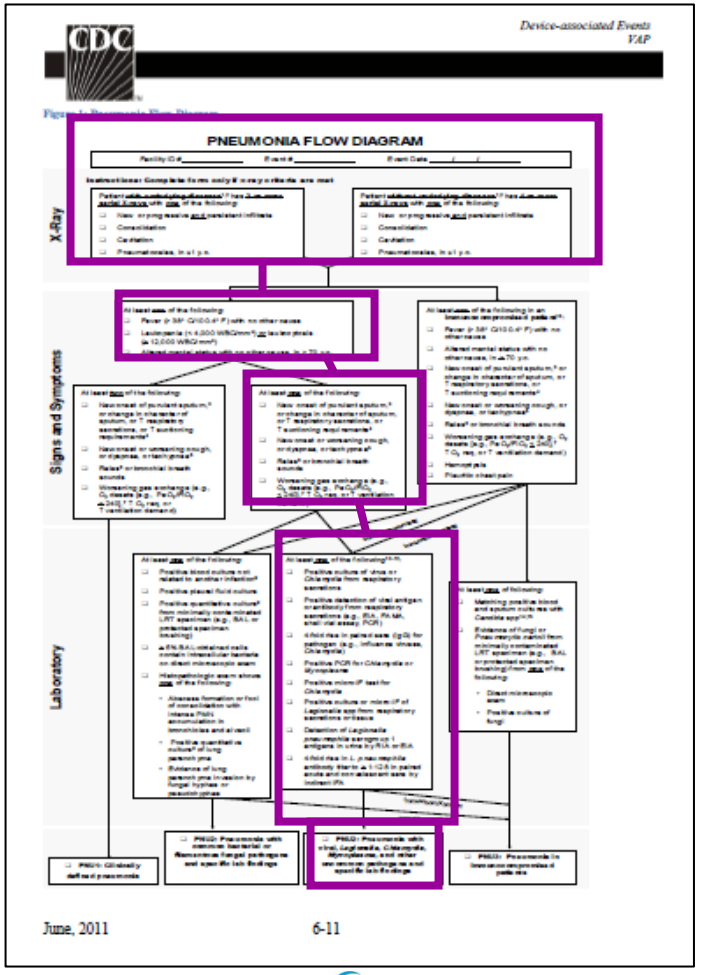
NHSN Pneumonia Definition Algorithm

PNU2 (continued)

2. Pneumonia with viral, Legionella, Chlamydia, Mycoplasma, and other uncommon pathogens and specific lab findings

- X-ray, signs /symptoms and lab data criteria must be met



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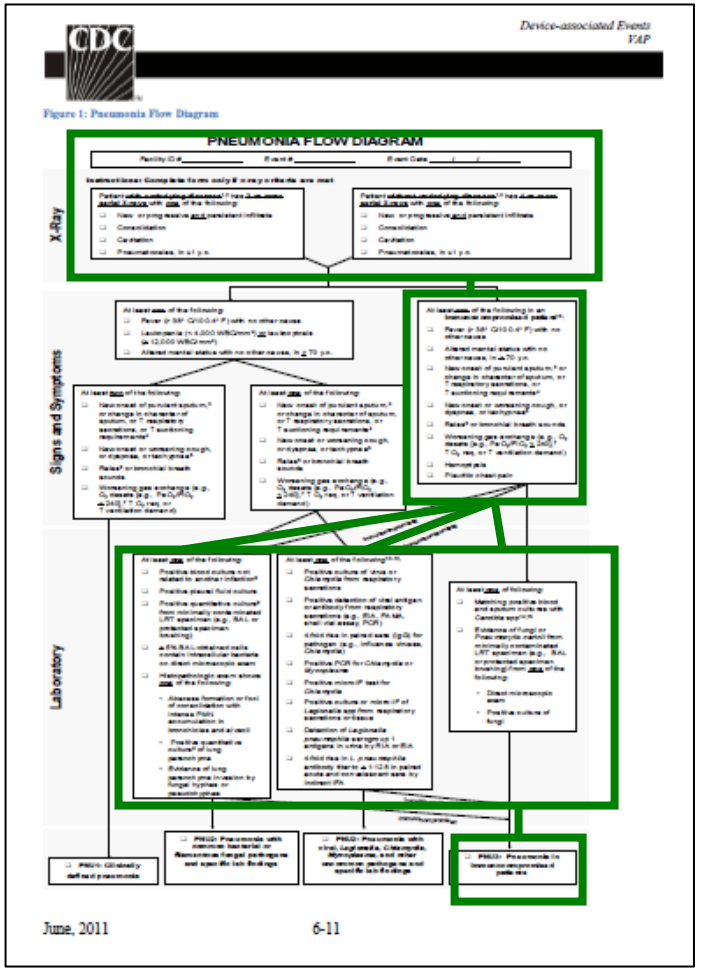
NHSN Pneumonia Definition Algorithm

Pneumonia in immunocompromised patients (PNU3)

- Patient must meet CDC criteria for being immunocompromised
- X-ray, signs /symptoms and lab data criteria must be met, as indicated



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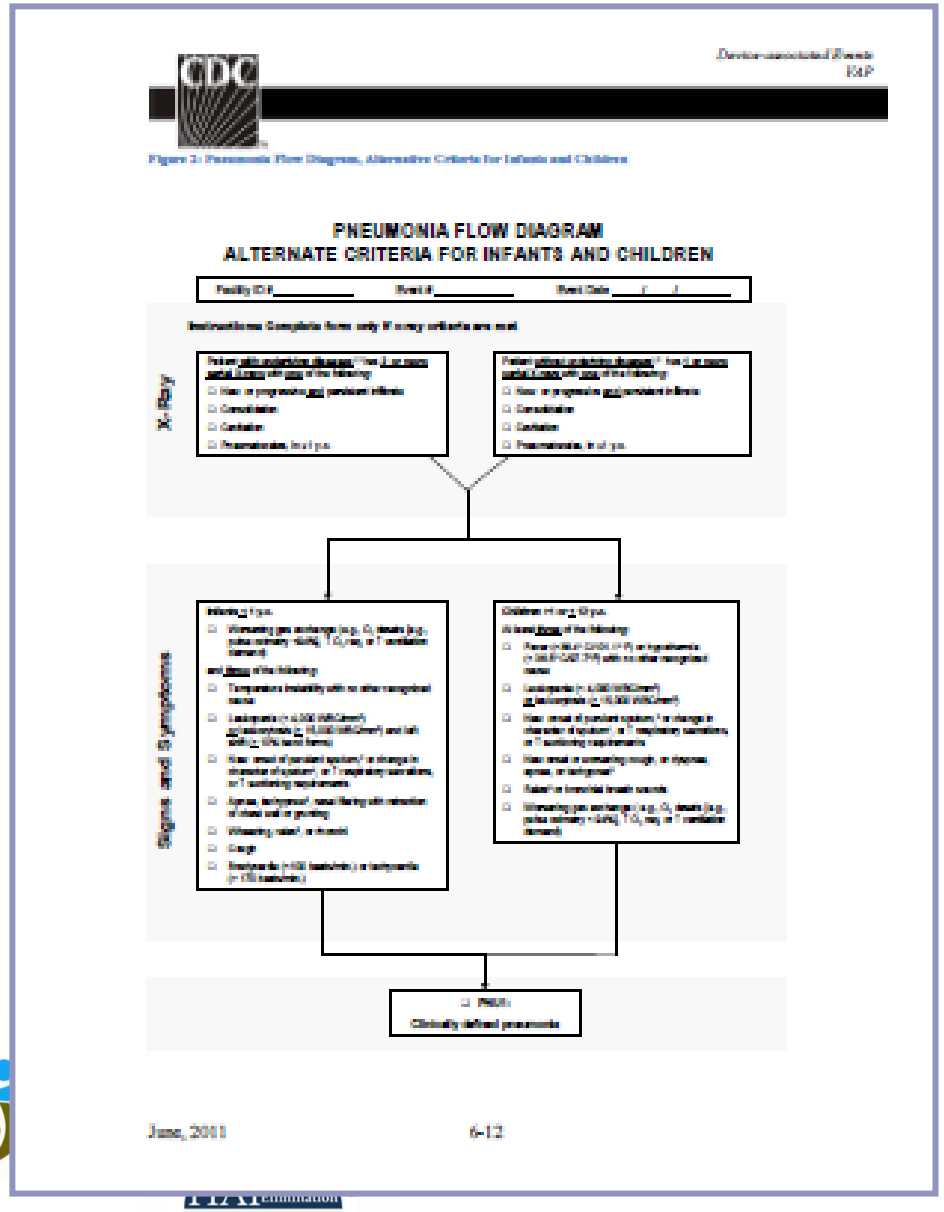

Additional algorithm for clinically-defined pneumonia (PNU1) in infants and children

References for VAP Prevention and Bundles

- Institute for Healthcare Improvement (IHI):
  - http://www.ihi.org/knowledge/Pages/Changes/ImplementtheVentilatorBundle.aspx
- Agency for Healthcare Research and Quality (AHRQ):
  - http://www.innovations.ahrq.gov/content.aspx?id=2178
- VAP Getting Started Kit: Safer Healthcare Now (Canada)
  - http://www.saferhealthcarenow.ca/EN/Interventions/VAP/Documents/VAP%20One%20Pager.pdf

References and Resources

Coffin, S, et al. Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals. *Infect Control Hosp Epidemiol* 2008; 29:S31-S40.

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Magill, SS. (2010). Surveillance for ventilator-associated pneumonia at CDC: Current Approach, Challenges, and Future Directions. Retrieved from lecture notes online website: http://www.hhs.gov/ash/initiatives/hai/Events/progresstoward-day2-magill.pdf

Questions?

For more information, please contact any HAI Liaison Team member.

Thank you